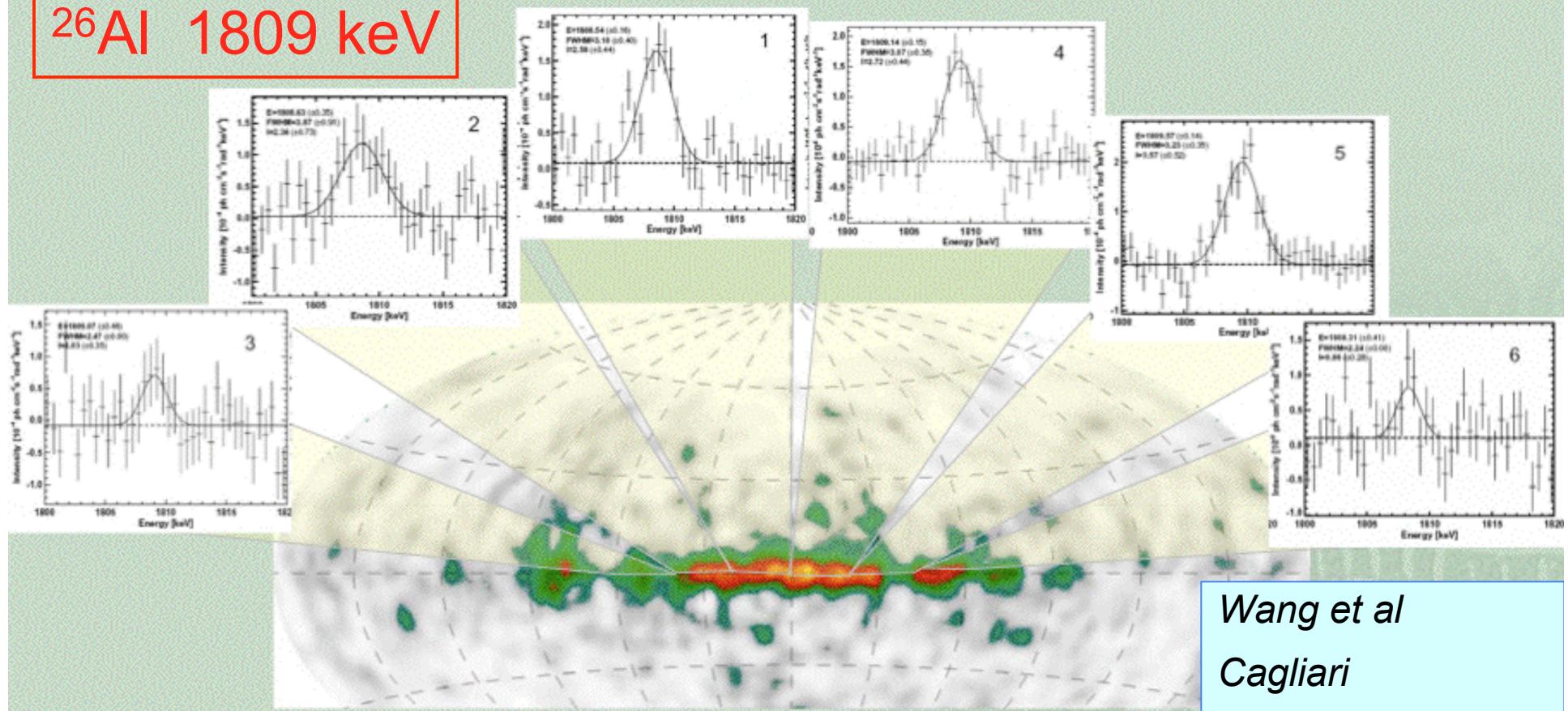


- Results from the “5 Years of Integral” meeting
(Cagliari, Sardinia)
- Some mission highlights suggested by Volker Beckman
- A new 511 keV result

Spectral Variation along the Plane of the Galaxy

6 segments, 20-degree longitude bin ($-60^\circ < l < 60^\circ$)

^{26}Al 1809 keV



Wang et al
Cagliari
Overall $\sim 30\sigma$

- Intensities: consistent with the COMPTEL Image
- Broad line feature toward $l \sim 20^\circ - 40^\circ$ (Sagittarius arm)

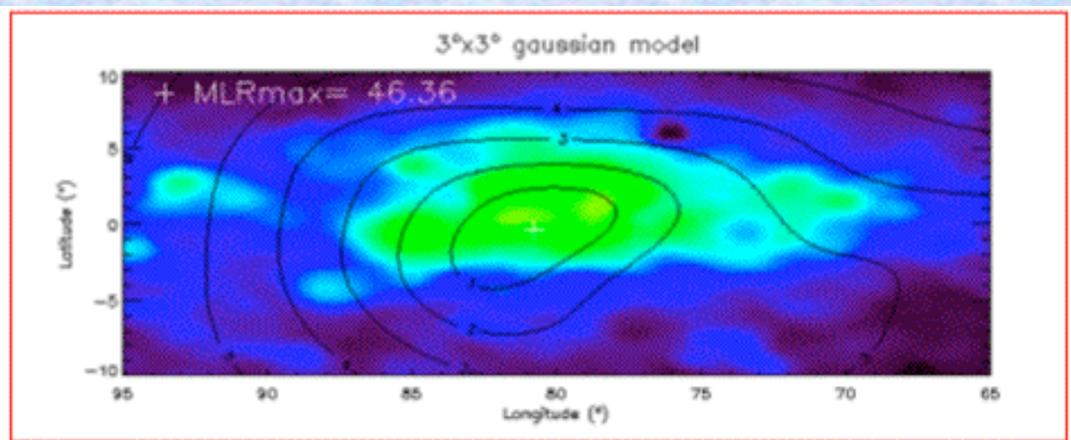
^{26}Al 1809 keV gamma-rays from star-forming regions

Cygnus $(7.2 \pm 1.2) \times 10^{-5} \text{ cm}^{-2}\text{s}^{-1}$ = 6σ

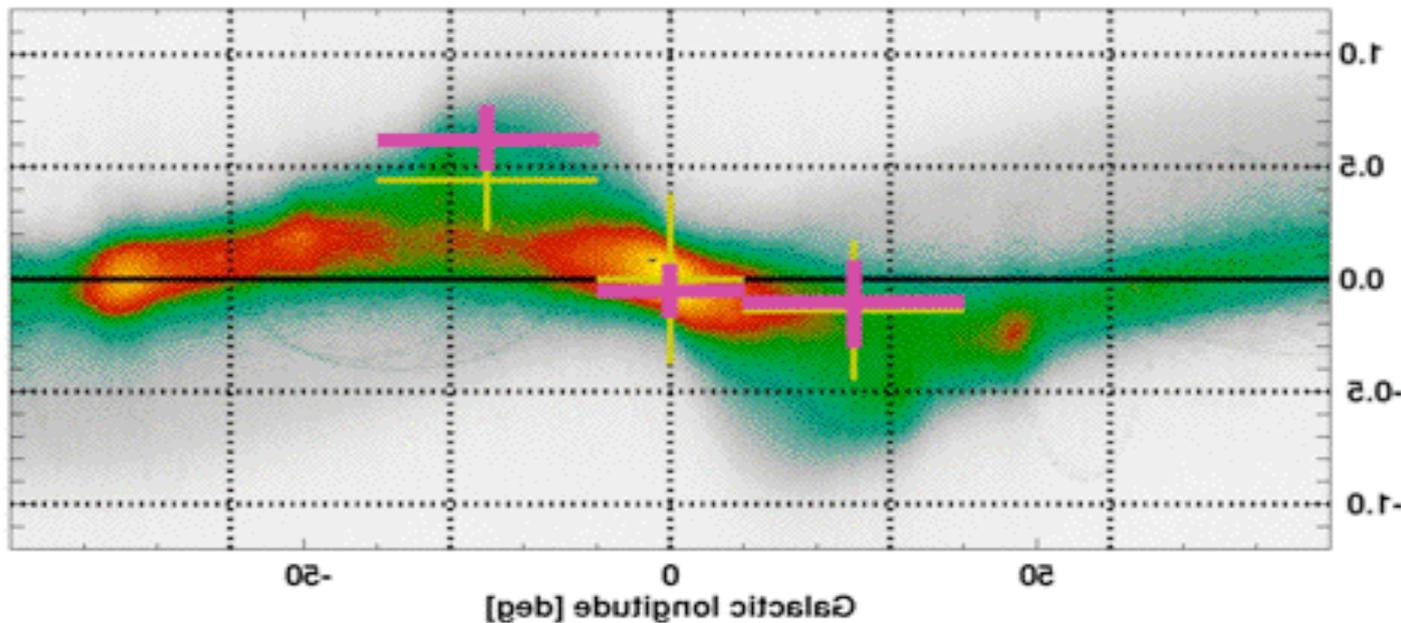
*Wang et al
(Cagliari)*

Vela $(4.1 \pm 1.2) \times 10^{-5} \text{ cm}^{-2}\text{s}^{-1}$ = 3.4σ

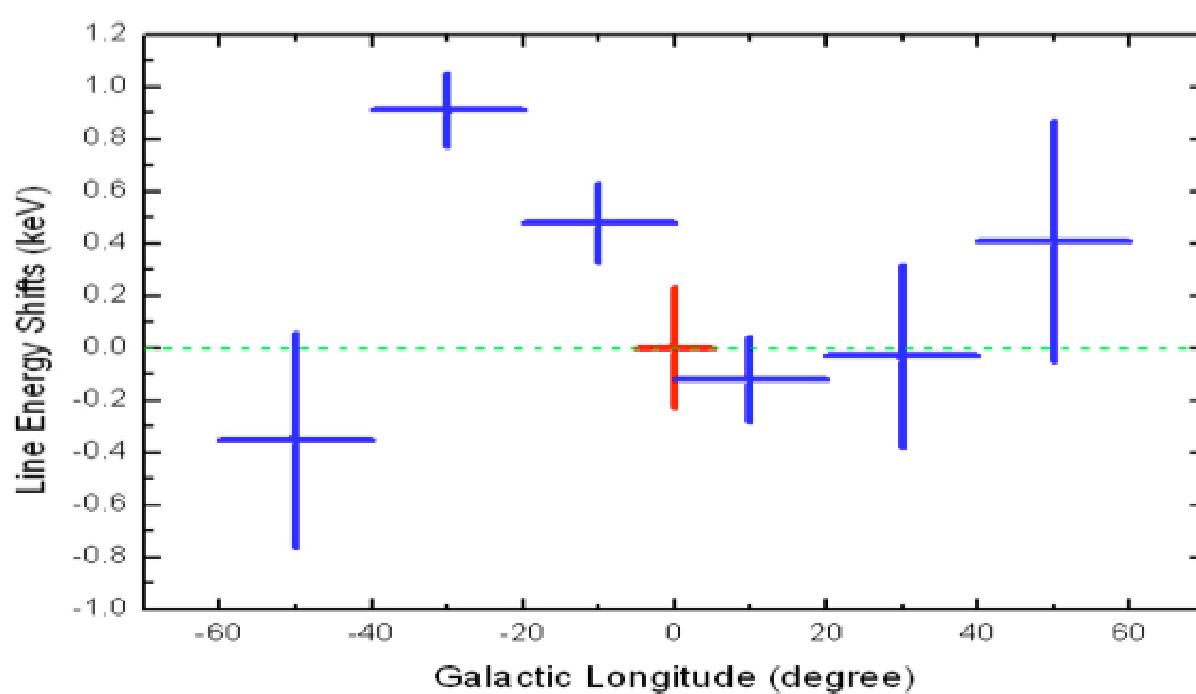
Sco-Cen $(6.7 \pm 2.0) \times 10^{-5} \text{ cm}^{-2}\text{s}^{-1}$ = 3.3σ



*Martin & Knodlseder (Cagliari)
Cygnus 1809 map (on WMAP
free-free emission map)*



*Diehl et al
(Nature, 2006)
(Update in red)*



Galactic rotation
cannot explain this
asymmetry.

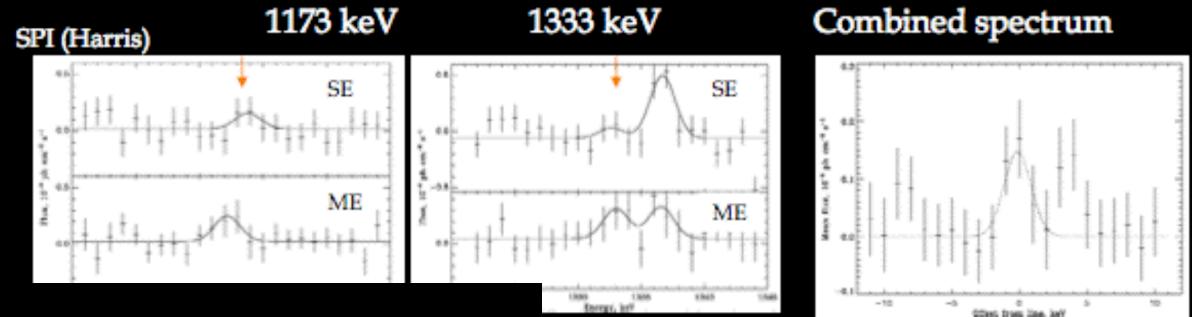
Other effects:
Galactic Bar, or
local ^{26}Al sources

*Wang et al
(Cagliari)*

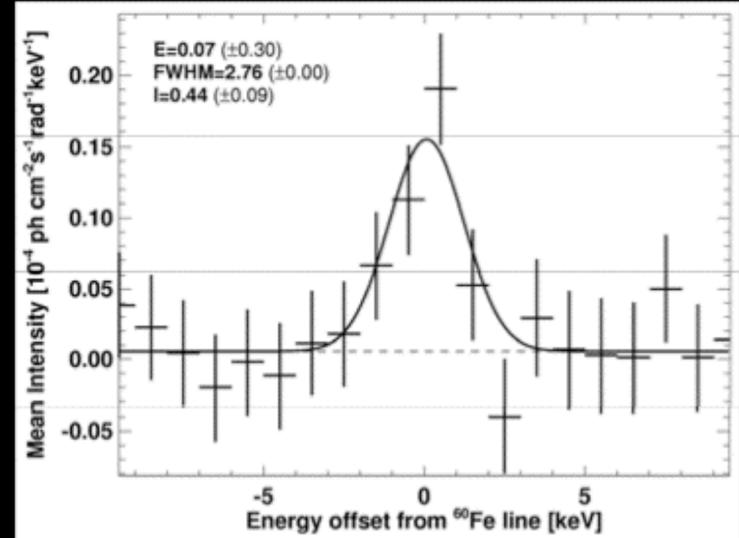
Lang et al (Cagliari)

$$^{60}\text{Fe}/^{29}\text{Al} = 15 \pm 6\%$$

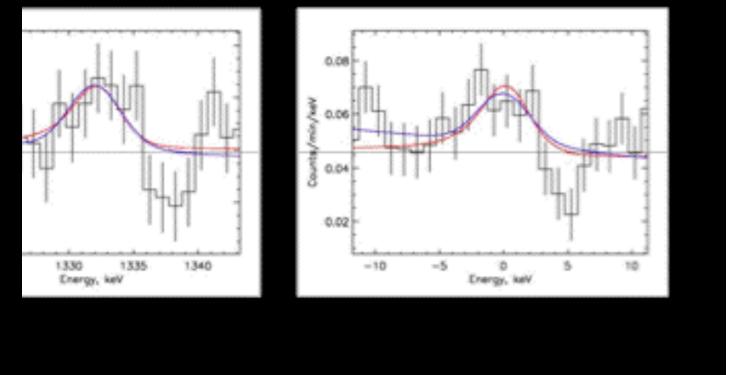
^{60}Fe Detection - Past (2005)



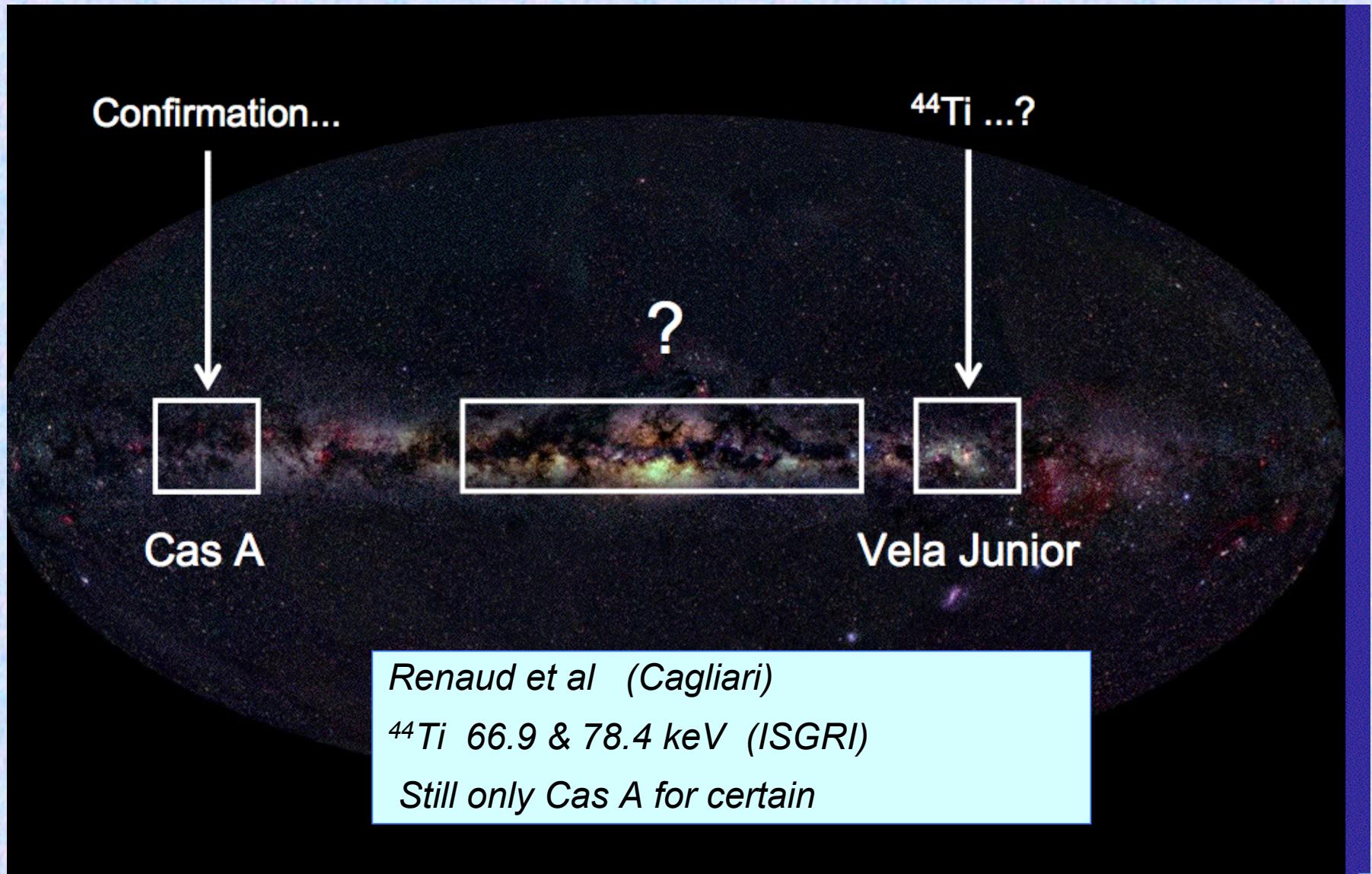
^{60}Fe Detection - Combination



→ Combined emission: $(4.4 \pm 0.9) \times 10^{-5} \text{ ph cm}^{-2} \text{s}^{-1} \text{rad}^{-1}$



Gerry Skinner
Integral Users Group
Meeting GSFC Nov-
27-2007



Cataclysmic Variables

21 detections (4 new) ~10% of Galactic sources
Mainly magnetic (11 Intermediate Polars)
Vast majority $P_{\text{orb}} > 3$ hrs

Symbiotic Stars

RT Cru = IGR J12349-6434
CD -57 3057 - IGR J10109-5746

In some case emission extends to 80 keV

Hudec (Cagliari)
Landi (Cagliari)

Super-Giant X-ray Transients (SGXBs)

- a) Strongly absorbed : $N_H \sim 10^{23}$ (13/17)
- b) Not strongly absorbed - new class (4/17)

Super-Giant FAST X-ray Transients (SFXBs)

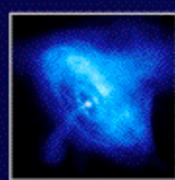
Duration mostly 0.5 - 15 h
Now 9 known (Squera) 15(Zureta-Heras)

Neutron star passing through clumpy wind? (Chaty)

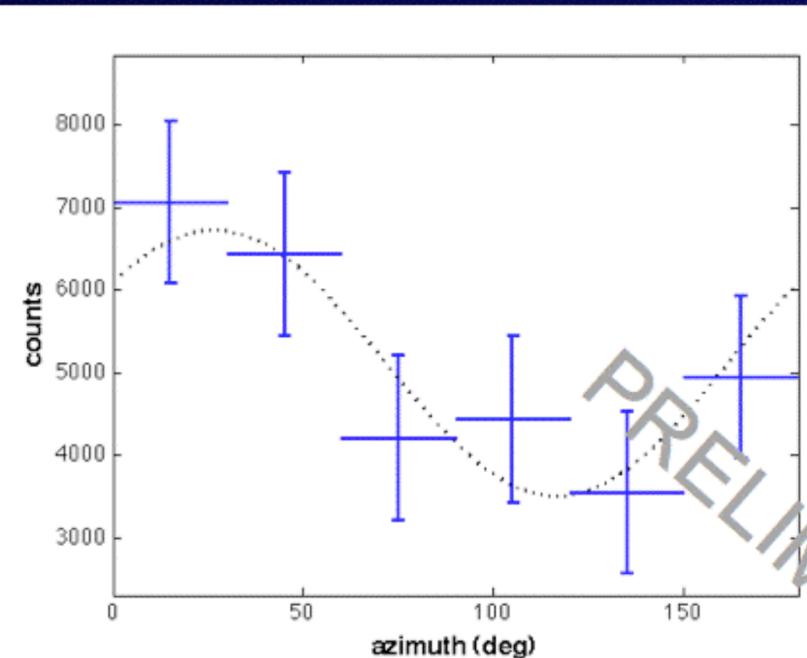
Sguera (Cagliari)

Zureta-Heras (Cagliari)

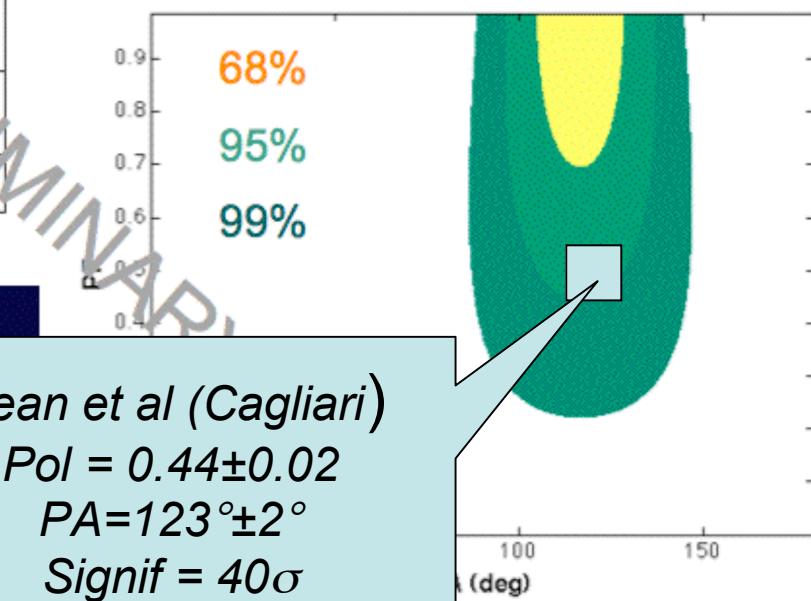
Chaty (Cagliari)



azimuth profile: off-pulse + bridge

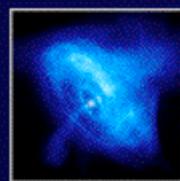


$$\text{PA} = 116.6^\circ \pm 7.9^\circ$$
$$\text{PF} = 1.04 \pm {}^{+0.30}_{-0.25}$$

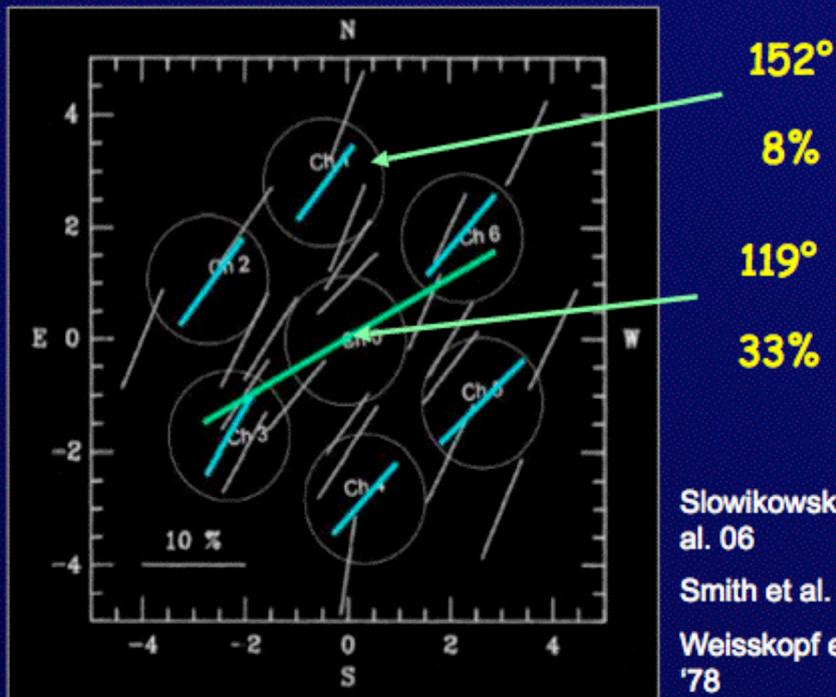
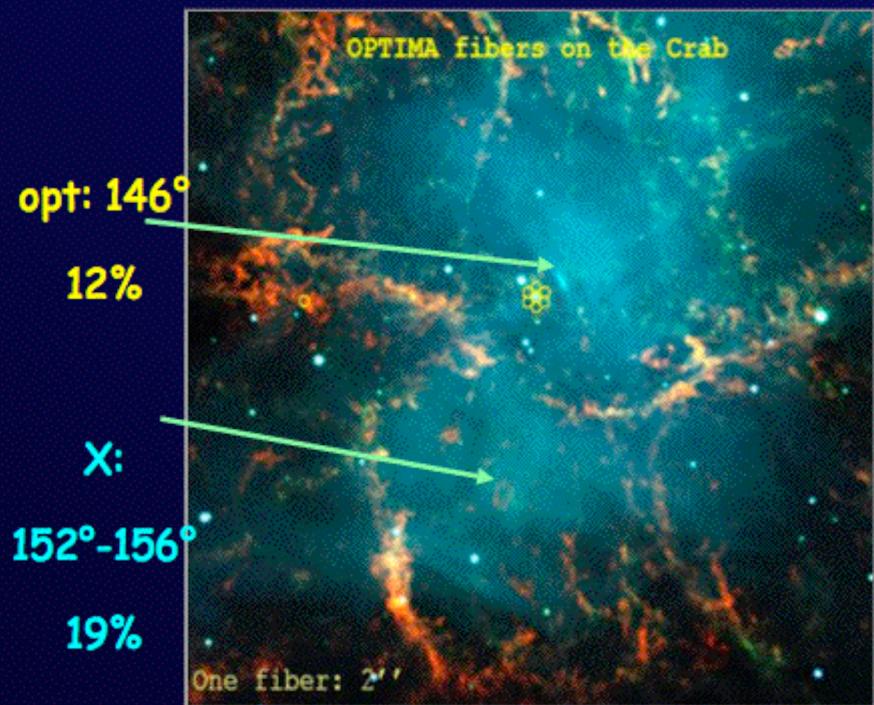


Dean et al (Cagliari)
 $\text{Pol} = 0.44 \pm 0.02$
 $\text{PA} = 123^\circ \pm 2^\circ$
 $\text{Signif} = 40\sigma$

$\text{proba}(a > a_0, \text{any } \varphi) = 8.7 \cdot 10^{-6}$



DC polarization // rotation axis



Slowikowska et al. 06
Smith et al. '88
Weisskopf et al. '78

- polarization angles
 - off-pulse: PA = $121.0^\circ \pm 10.0^\circ$
 - optical r < 0.01 pc: PA = 119°
 - projected rotation axis: $124.0^\circ \pm 0.1^\circ$

Romani '04

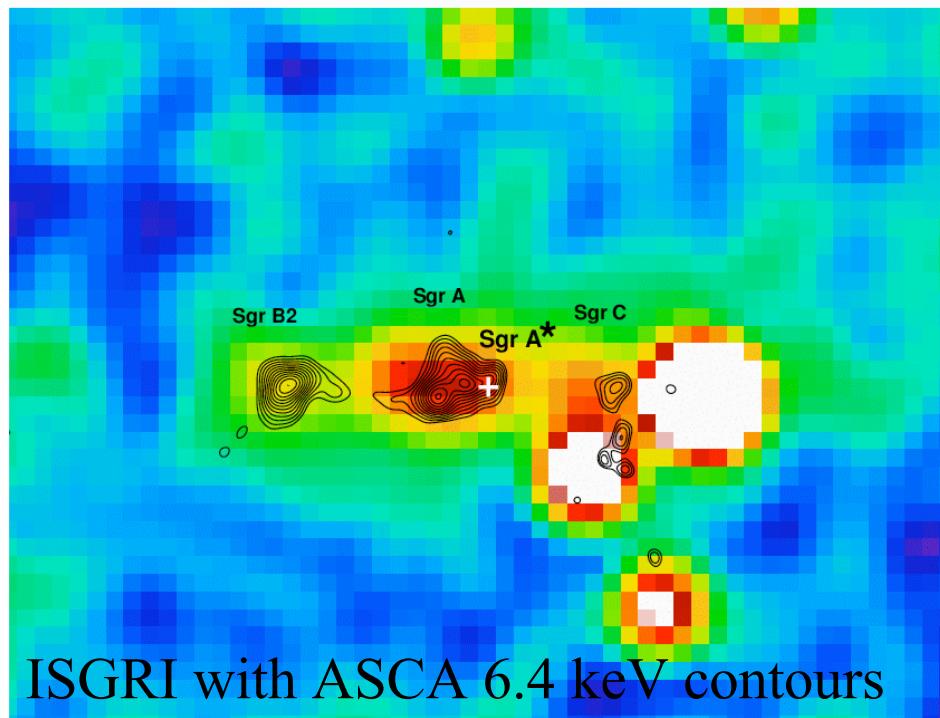
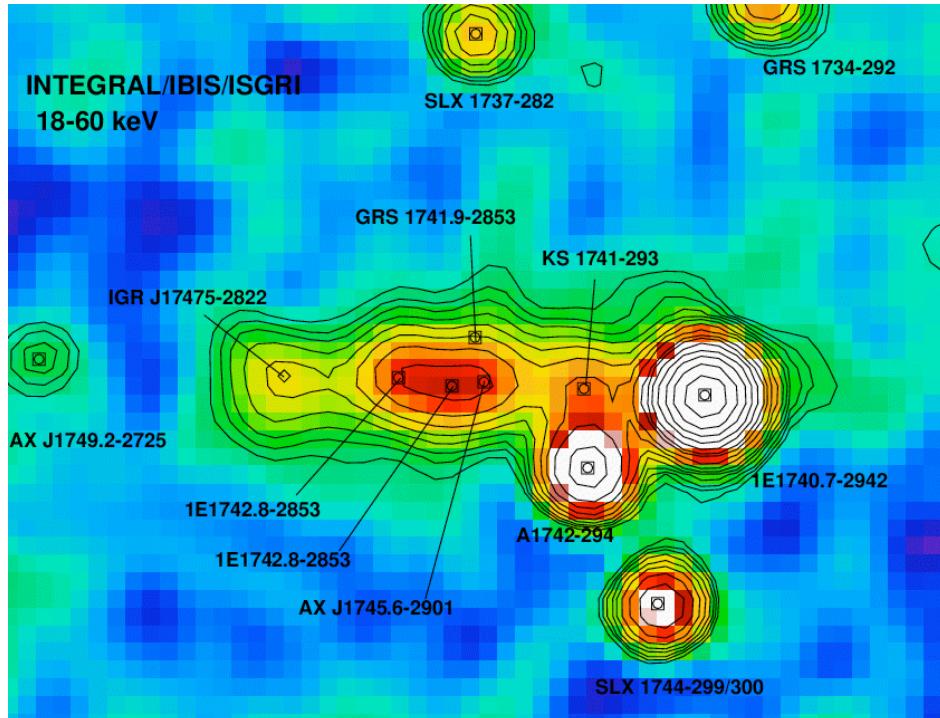
Ng &

- any toroidal B field
 - jet
 - shocked wind torus
 - striped wind

From Volker Beckmann

Science Highlights

- 5 years of successful operation
 - resolving the Galactic Centre
 - new sources & highly absorbed binary systems
 - Supergiant Fast X-ray Transients
 - Diffuse emission in the Galaxy
 - Active Galactic Nuclei and the connection to cosmic evolution
 - Gamma-Ray Bursts, Gamma-Ray Repeaters and magnetars
-
- more results & references: 0710.4248



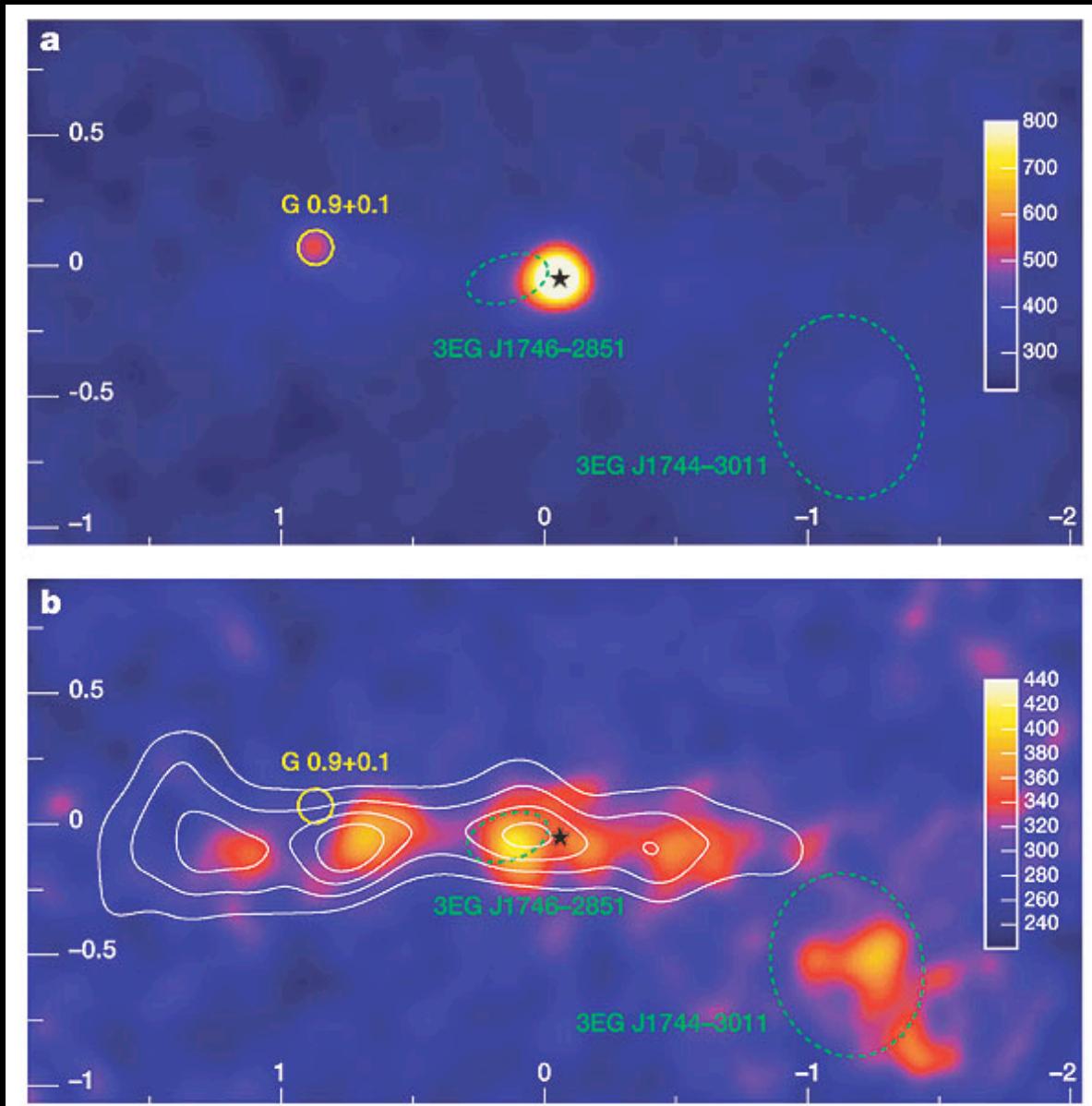
A giant molecular cloud functioning
as a “Compton mirror” of Sgr A*

Revnivtsev et al. 2004

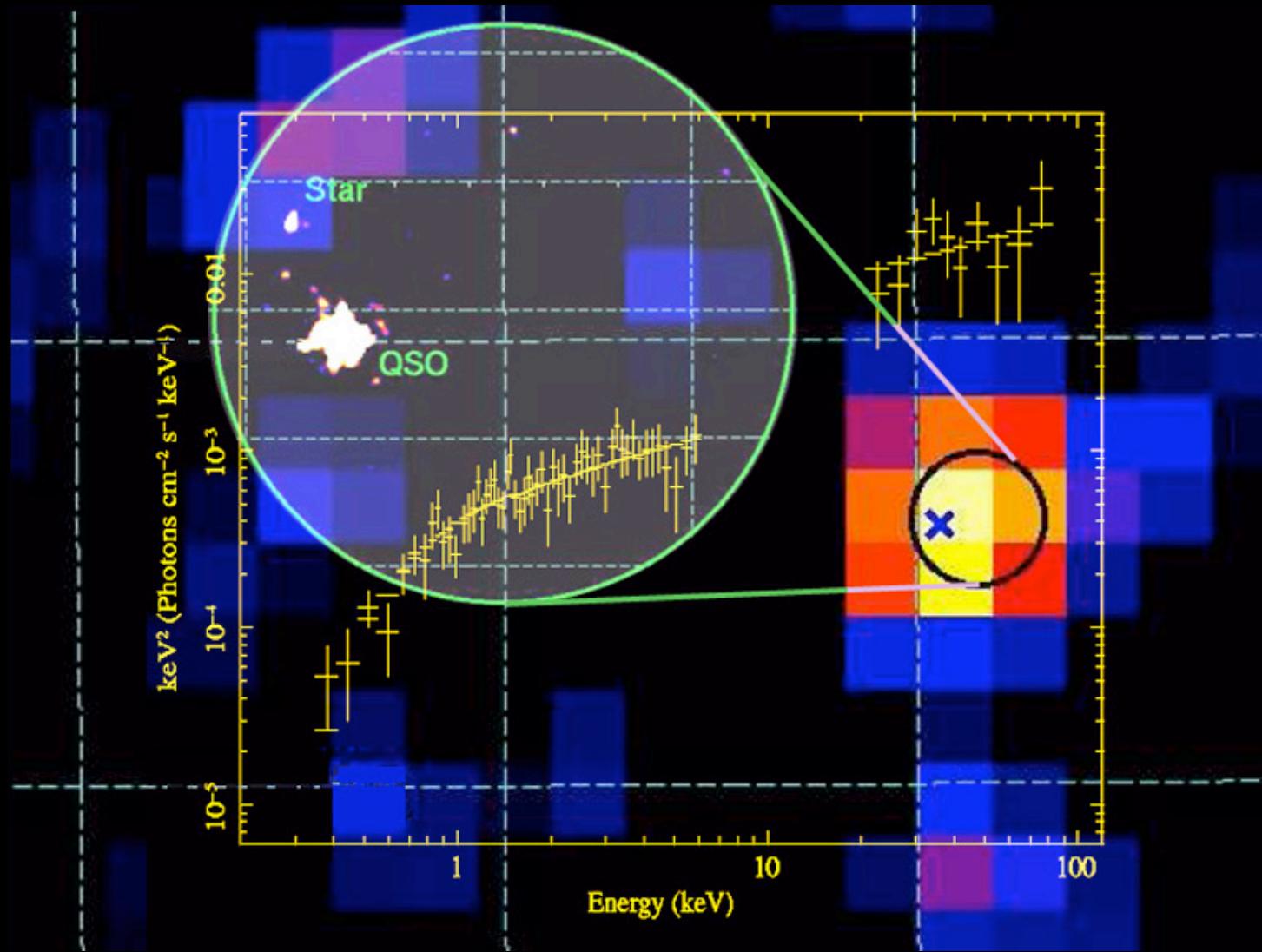


Belanger et al. 2004, 2006

Giant molecular clouds functioning as a
“Compton mirror” of Sgr A* - also in the TeV range!



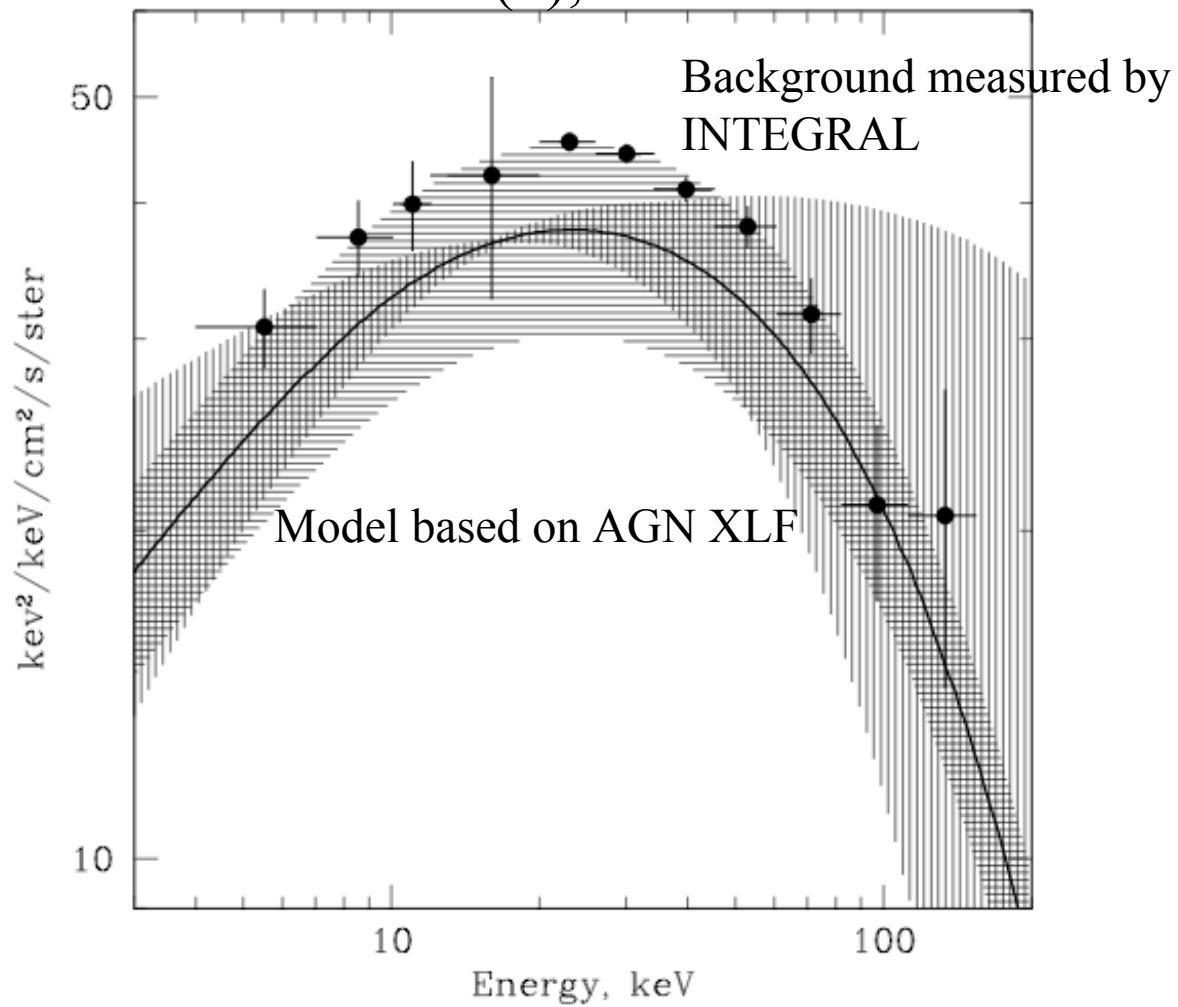
Aharonian et al. 2006



Blazar at $z=3.7$, seen by INTEGRAL (Bassani et al. 2007)

Comparison with CXB

Density $e_2(z) \propto (1 + z)^{3.2}$ for $z \leq 1$
 $e_2(1)$, constant for $z > 1$

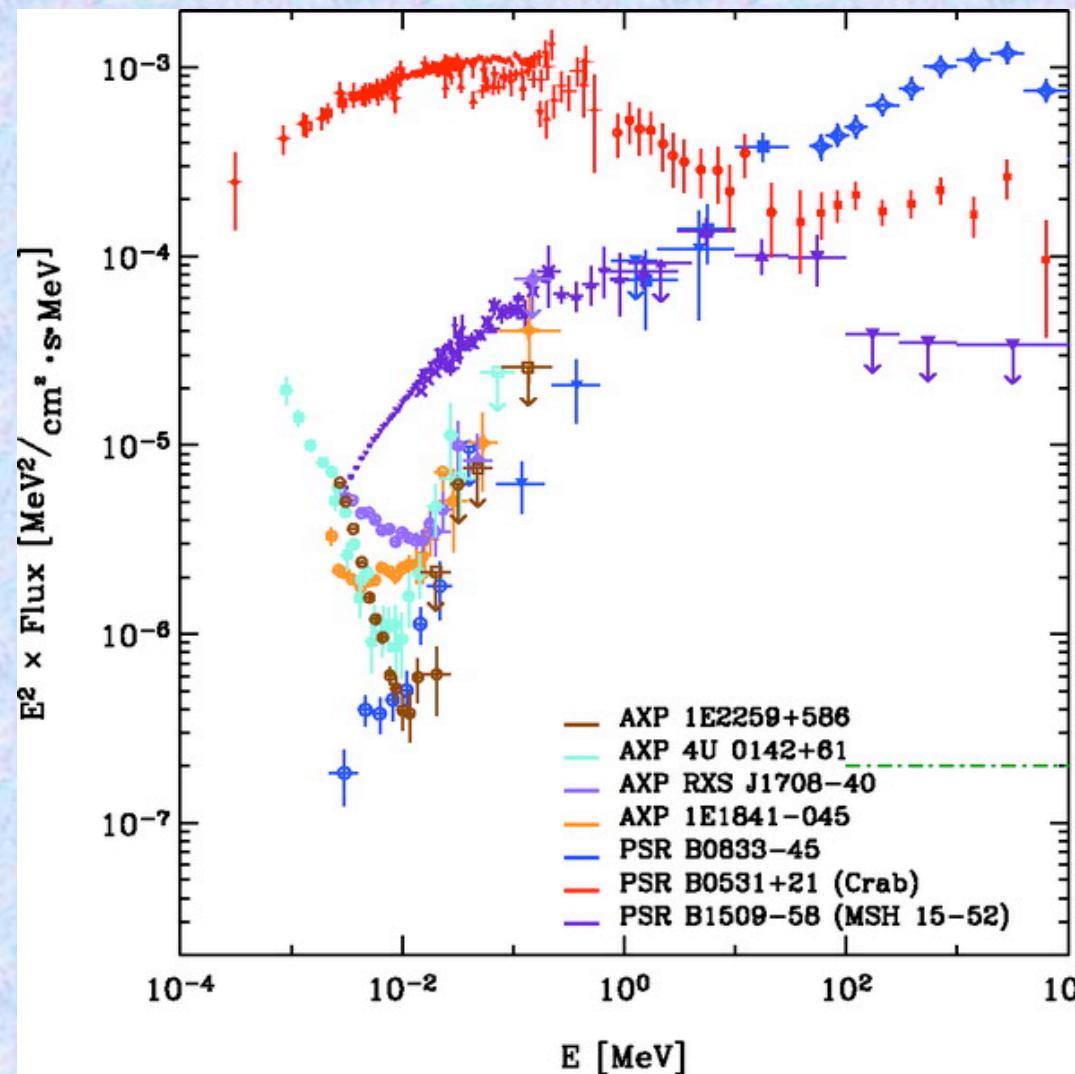


Evolution in AGN population necessary to explain
observed Cosmic X-ray background

Sazonov et al. 2007
Beckmann et al. 2006

Hard pulsed emission from AXPs

- AXPs (magnetars) show extremely hard X-ray spectra
- up to 100% of the hard X-ray emission is pulsed (Kuiper et al. 2006)



Kuiper et al. 2006
ApJ, 645, 556

511 keV positron annihilation line - a recent result

~ 4.5 years of observations

From November 2002 to March 2007

- exposure time ~ 54 Ms.

MREM image

Model fitting

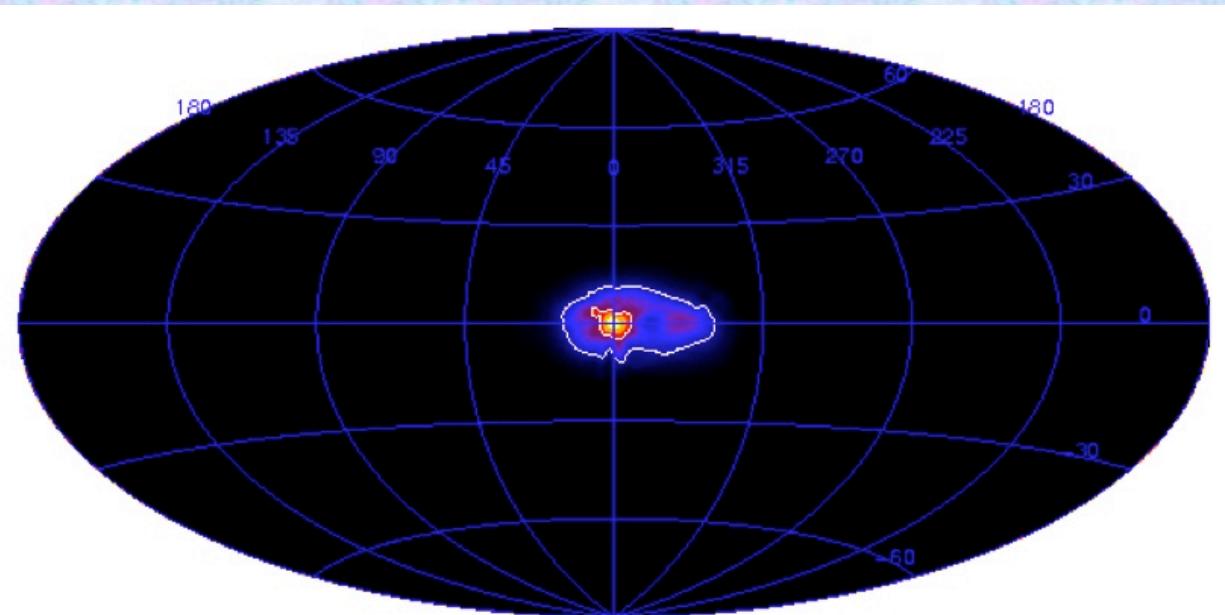
Central bulge component :

not simple Gaussian

Narrow (3.3° and 11° FWHM)

or 'Halo'

Disk component:

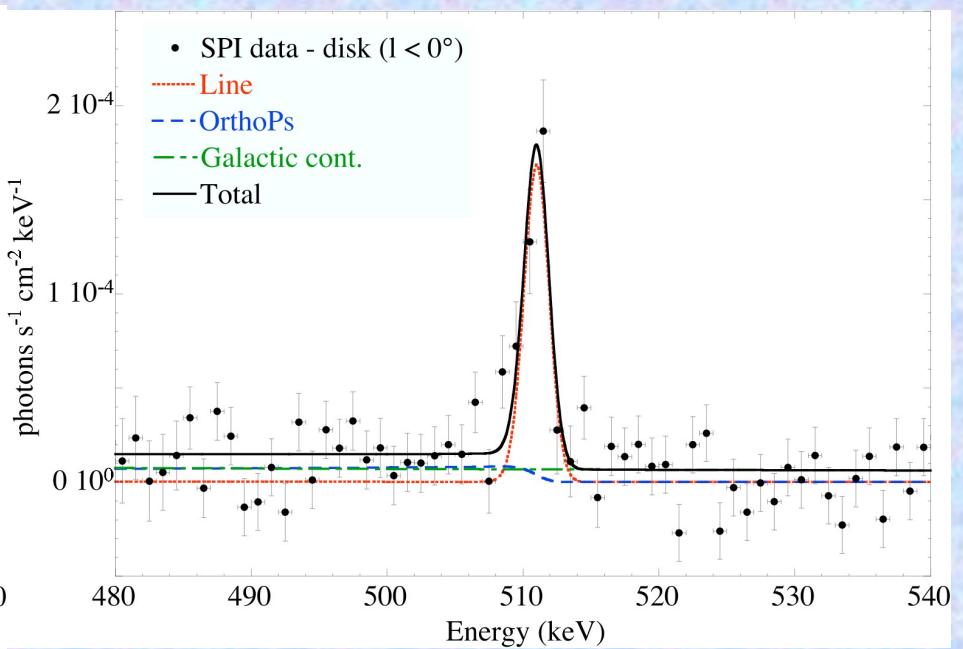
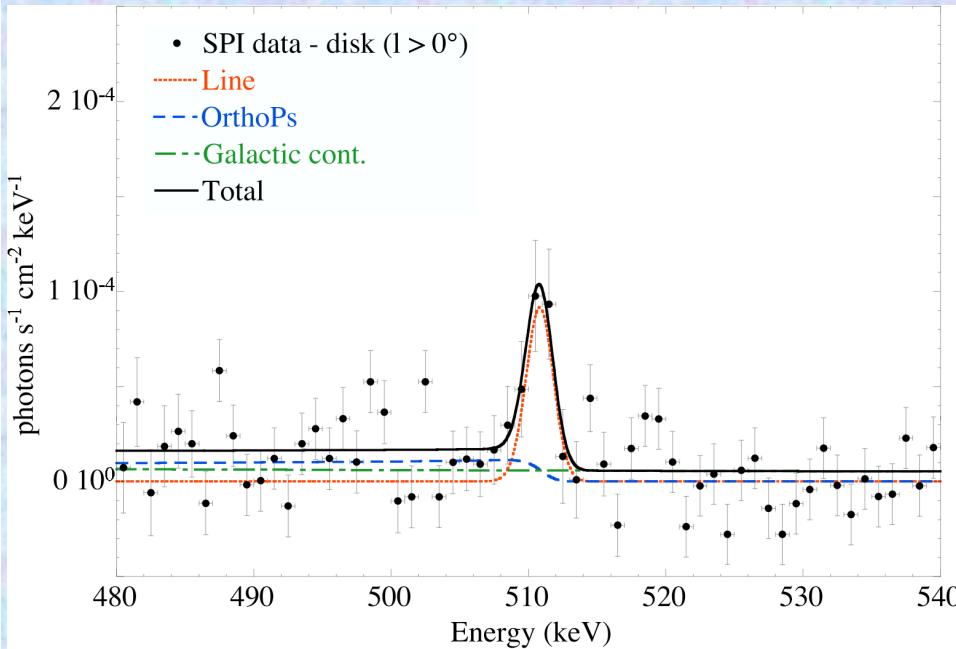


Weidenspointner et al.
"An asymmetric distribution
of positrons in the Galactic disk"
Nature, to be published

511 keV positron annihilation line - a recent result

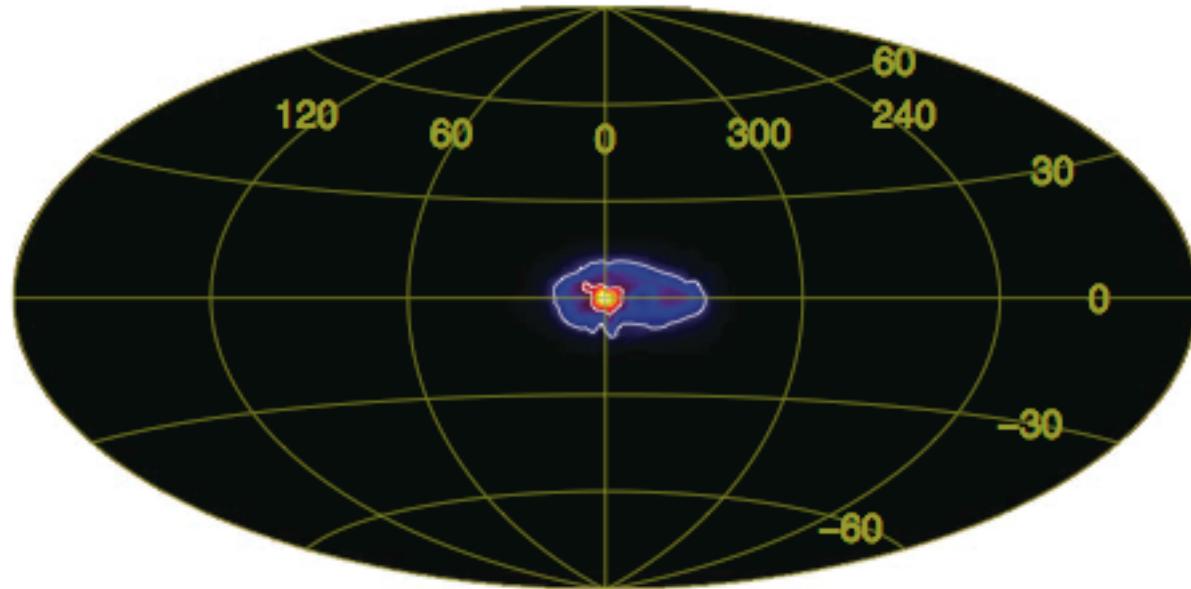
$$F_+ = (2.4 \pm 0.5) \times 10^{-4} \text{ s}^{-1} \text{ cm}^{-2}$$

$$F_- = (4.3 \pm 0.5) \times 10^{-4} \text{ s}^{-1} \text{ cm}^{-2}$$



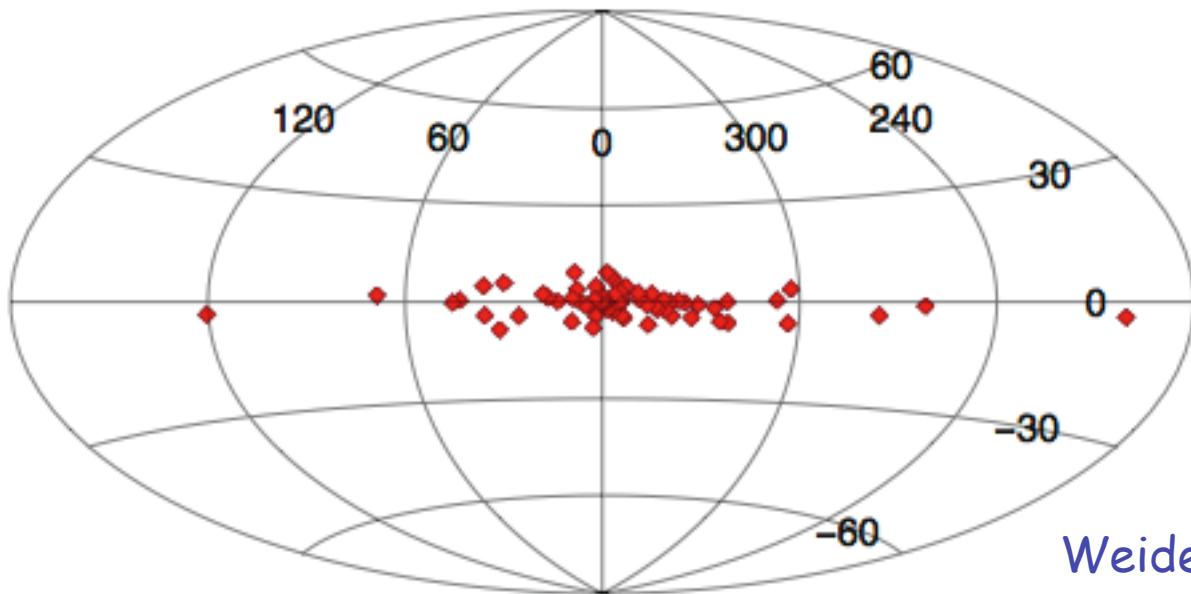
$$\text{Ratio} = F_- / F_+ = 1.8 \quad (3.8\sigma)$$

Weidenspointner et al.
 "An asymmetric distribution
 of positrons in the Galactic disk"
 Nature, to be published



511 keV line

Ratio $F_-/F_+ = 1.8-2.2$



LMXBs in the
3rd IBIS catalogue
(Bird et al 2007)

Ratio $N_-/N_+ = 1.7$
(2.8 at higher energy)

- => LMXBs may be the dominant origin of e^+ in the disk.
- => Positron rate $\sim 10^{41} \text{ s}^{-1}$ per LMXB

Weidenspointner et al.
"An asymmetric distribution
of positrons in the Galactic disk"
Nature, to be published

End